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Satellite Based PM_{2.5} Data Sets and Access

Pawan Gupta

**Satellite Remote Sensing of Air Quality: Data, Tools,
and Applications**

Tuesday, May 23, 2017 – Friday, May 26, 2017

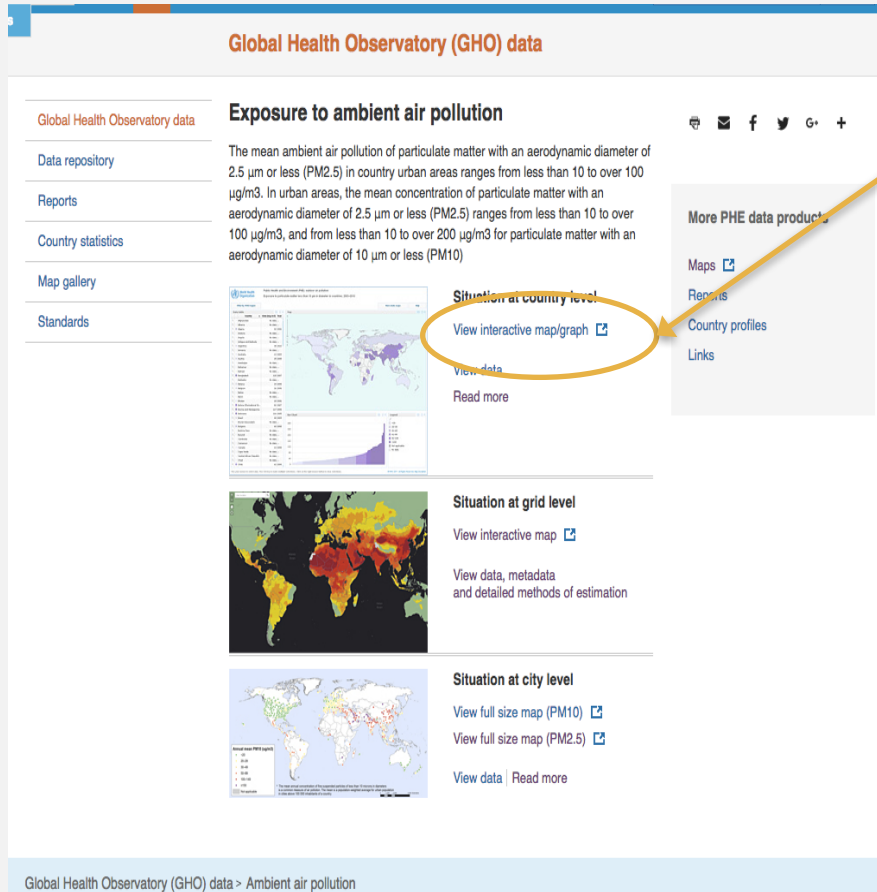
Indian Institute of Tropical Meteorology, Pune, India



WHO PM_{2.5} Data Sets

Where to Find and View the Data

WHO Website: Country Level



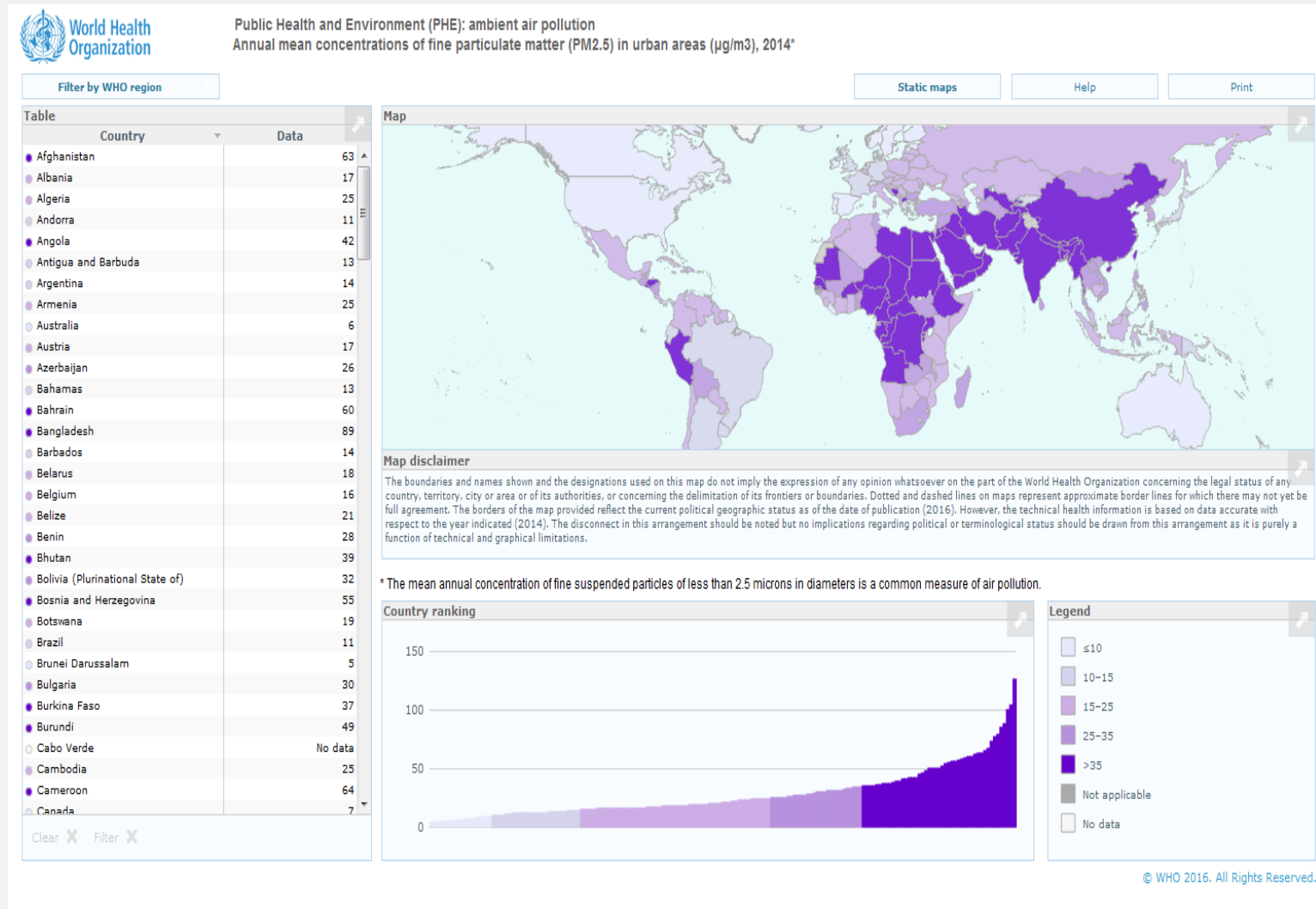
Follow this link to download 2014 country level data:

- Formats: csv, Excel, html, XML, etc.
- Can also filter by country and download

http://www.who.int/gho/phe/outdoor_air_pollution/exposure/en/

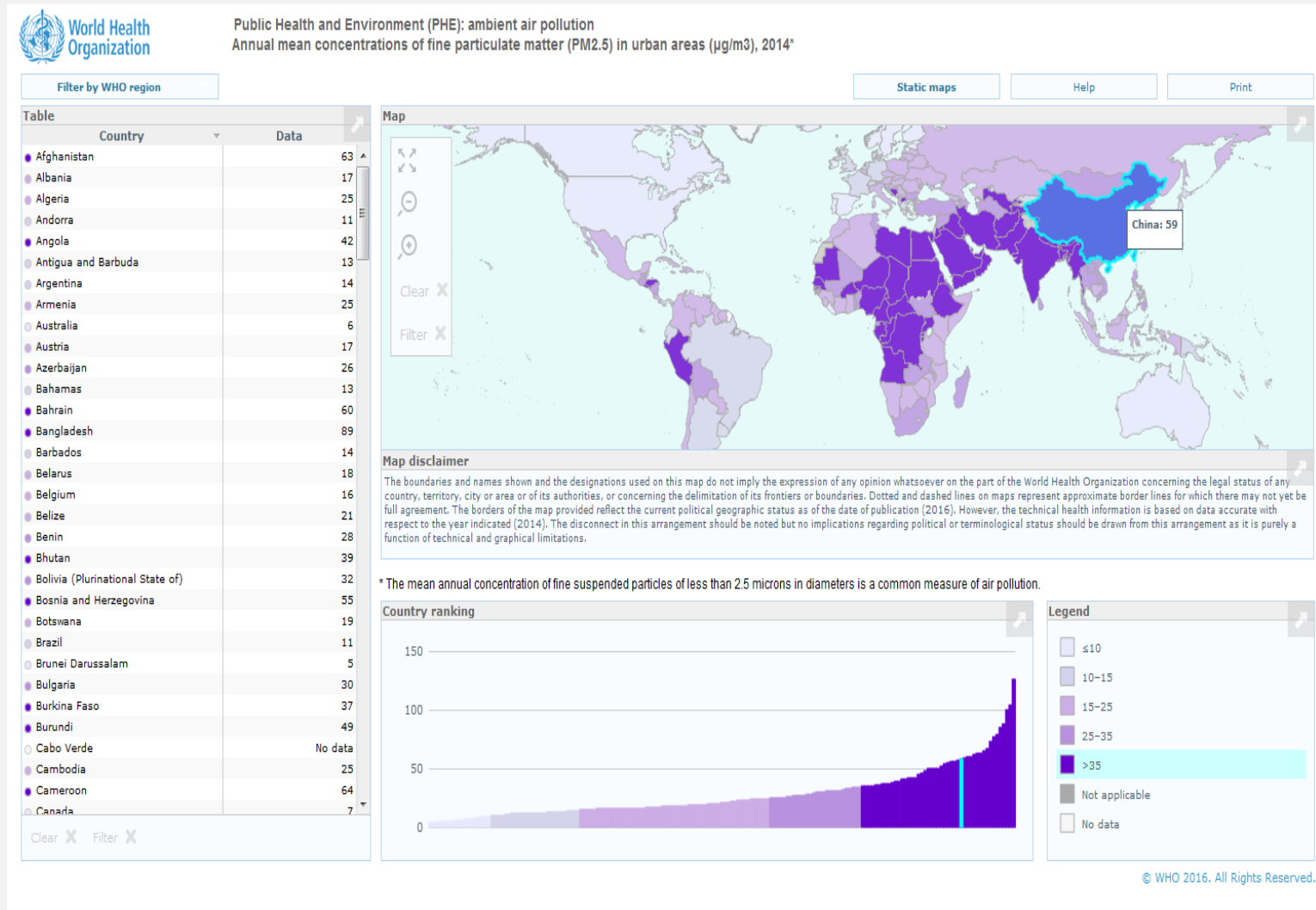
PM_{2.5} at Country Level

http://gamapserver.who.int/gho/interactive_charts/phe/oap_exposure/atlas.html



PM_{2.5} at Country Level

http://gamapserver.who.int/gho/interactive_charts/phe/oap_exposure/atlas.html



Where to Find and View the Data

WHO Website: Country Level

The screenshot shows the WHO Global Health Observatory (GHO) data page for "Exposure to ambient air pollution". The page is in English and features a blue header with the WHO logo and navigation links. A sidebar on the left lists "Global Health Observatory data", "Data repository", "Reports", "Country statistics", "Map gallery", and "Standards". The main content area is titled "Exposure to ambient air pollution" and includes a paragraph describing the mean ambient air pollution of particulate matter with an aerodynamic diameter of 2.5 µm or less (PM2.5) in country urban areas. Below this, there are three sections: "Situation at country level", "Situation at grid level", and "Situation at city level". The "Situation at grid level" section is circled in orange, and an orange arrow points to it from the right. The "Situation at city level" section is also visible. The "More PHE data products" sidebar on the right lists "Maps", "Reports", "Country profiles", and "Links".

Global Health Observatory (GHO) data

Exposure to ambient air pollution

The mean ambient air pollution of particulate matter with an aerodynamic diameter of 2.5 µm or less (PM2.5) in country urban areas ranges from less than 10 to over 100 µg/m3. In urban areas, the mean concentration of particulate matter with an aerodynamic diameter of 2.5 µm or less (PM2.5) ranges from less than 10 to over 100 µg/m3, and from less than 10 to over 200 µg/m3 for particulate matter with an aerodynamic diameter of 10 µm or less (PM10)

Situation at country level

View interactive map/graph

View data

Read more

Situation at grid level

View interactive map

View data, metadata and detailed methods of estimation

Situation at city level

View full size map (PM10)

View full size map (PM2.5)

View data | Read more

More PHE data products

Maps

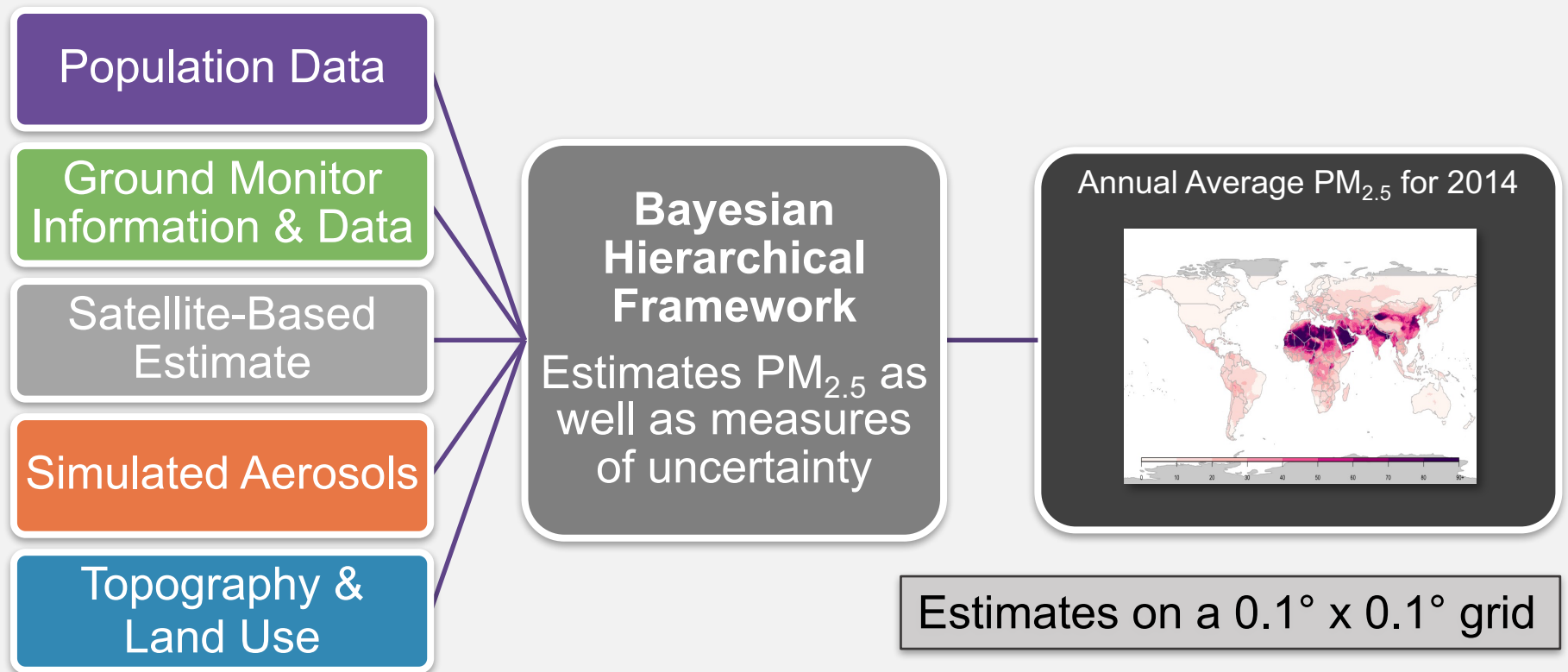
Reports

Country profiles

Links

http://www.who.int/gho/phe/outdoor_air_pollution/exposure/en/

Data Integration Model for Air Quality (DIMAQ)



Shaddick et al. 2016, submitted, Figure 7 (top)

PM_{2.5} at Grid Level

http://www.who.int/phe/health_topics/outdoorair/databases/modelled-estimates/en/

The screenshot shows the WHO website's 'Public health, environmental and social determinants of health (PHE)' section. The main heading is 'Modelled Global Ambient Air Pollution estimates'. The text describes the DIMAQ model, which produces estimates of annual exposures of PM_{2.5} levels at high spatial resolution (0.1° × 0.1°, which equates to approximately 11x11km at the equator) globally. It mentions that the sources of data include ground measurements from 6 003 monitoring locations around the world, satellite remote sensing, population estimates, topography, and information on local monitoring networks and measures of specific contributors of pollution from chemical transport models. The DIMAQ model calibrates data from these sources with ground measurements. This model has provided produced estimates of air quality, expressed in terms of median concentrations of PM_{2.5}, for regions of the world, including areas in which PM_{2.5} monitoring is not available. It also states that this model has been developed by an international group of experts and led by the University of Bath and WHO. Below the text, there are four links with download icons: 'Global ambient air pollution map', 'DIMAQ database, 2014 data', 'Detailed methods for DIMAQ', and 'Meta-data file for DIMAQ'. Arrows from the text boxes on the right point to these links: 'Map from previous slide' points to the first link, '.csv file with gridded PM_{2.5} estimates' points to the second link, 'Link to Shaddick et al. 2016 paper' points to the third link, and 'Meta-data for PM_{2.5} estimates' points to the fourth link. A 'Disclaimer' section at the bottom states: 'Wherever possible, estimates have been computed using standardized categories.'

Public health, environmental and social determinants of health

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Public health, environmental and social determinants of health (PHE)

Modelled Global Ambient Air Pollution estimates

Estimation of global health risks from exposure to ambient air pollution requires a comprehensive set of air pollution exposure data covering all inhabited areas. The recently developed Data Integration Model for Air Quality (DIMAQ) has produced estimates based on data from ground measurements together with information from other sources including data from satellite retrievals of aerosol optical depth and chemical transport models. It provides estimates of annual exposures of PM_{2.5} levels at high spatial resolution (0.1° × 0.1°, which equates to approximately 11x11km at the equator) globally.

The sources of data include: Ground measurements from 6 003 monitoring locations around the world, satellite remote sensing; population estimates; topography; and information on local monitoring networks and measures of specific contributors of pollution from chemical transport models. The DIMAQ model calibrates data from these sources with ground measurements. This model has provided produced estimates of air quality, expressed in terms of median concentrations of PM_{2.5}, for regions of the world, including areas in which PM_{2.5} monitoring is not available.

This model has been developed by an international group of experts and led by the University of Bath and WHO.

- Global ambient air pollution map
- DIMAQ database, 2014 data
- Detailed methods for DIMAQ
- Meta-data file for DIMAQ

Disclaimer

Wherever possible, estimates have been computed using standardized categories.

Map from previous slide

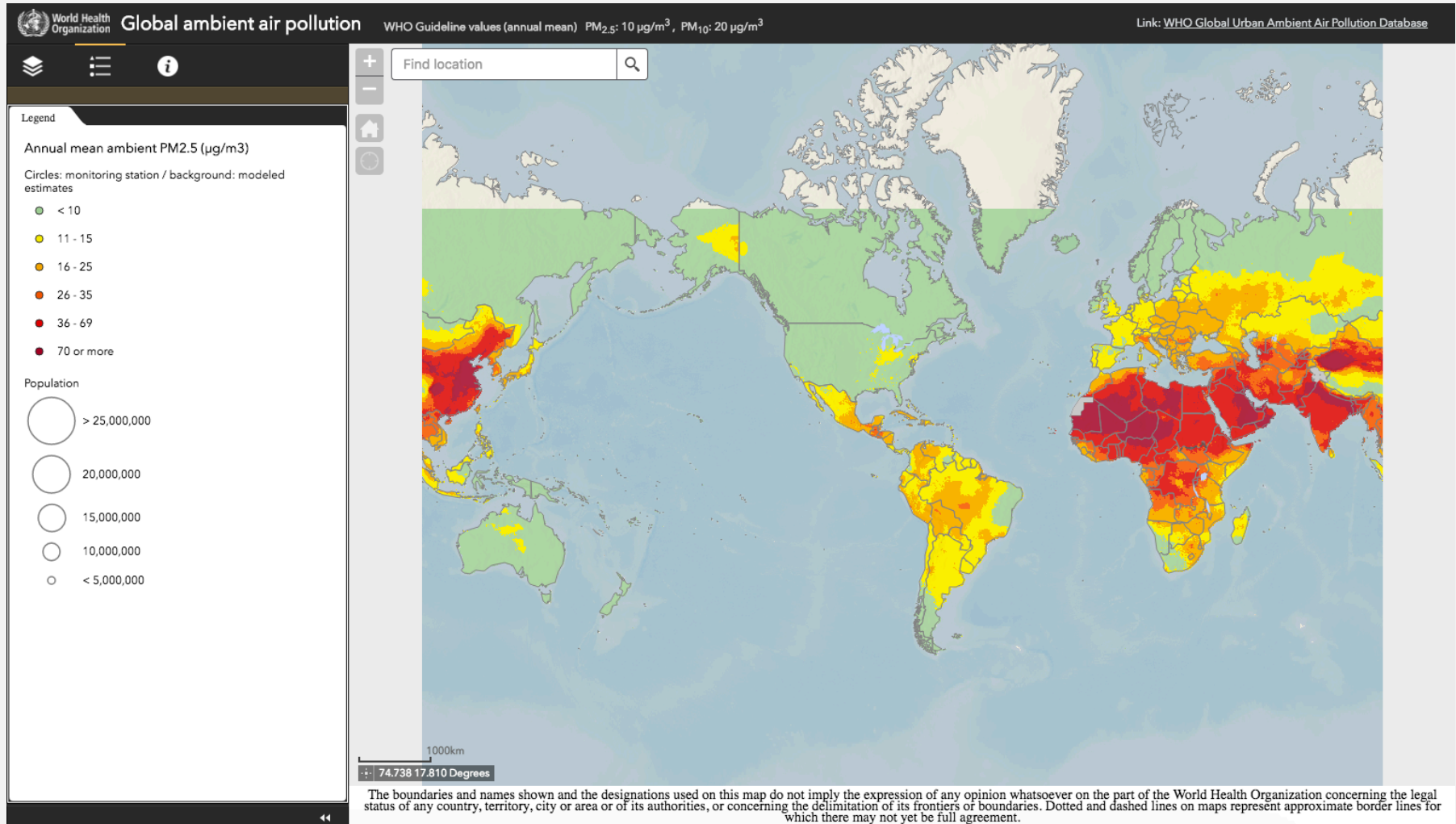
.csv file with gridded PM_{2.5} estimates

Link to Shaddick et al. 2016 paper

Meta-data for PM_{2.5} estimates

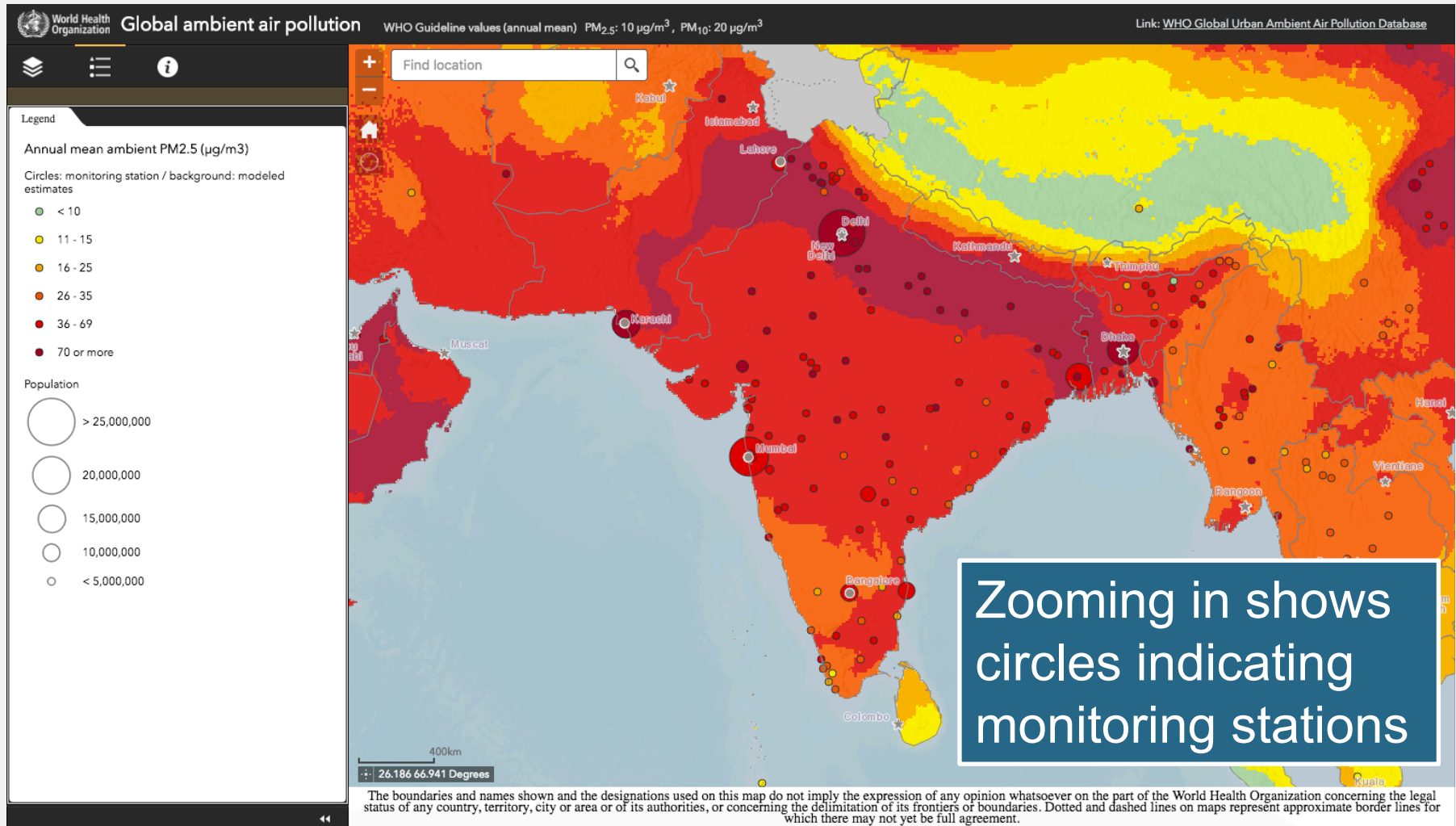
PM_{2.5} at Grid Level

<http://maps.who.int/airpollution/>




PM_{2.5} at Grid Level

<http://maps.who.int/airpollution/>




WHO PM_{2.5} Gridded Data: By Country

http://avdc.gsfc.nasa.gov/pub/tmp/WHO_PM25_2014_COUNTRY_DATA/

 GODDARD SPACE FLIGHT CENTER

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OVERVIEWDATA TOOLSDOCUMENTATIONLINKSEVENTS

[OVERVIEW/ HOME](#)

Name	Last modified	Size
Parent Directory	-	-
Afghanistan_AFG_2014_WHO_PM25.csv	15-Feb-2017 10:32	220K
Albania_ALB_2014_WHO_PM25.csv	15-Feb-2017 10:32	11K
Algeria_DZA_2014_WHO_PM25.csv	15-Feb-2017 10:32	760K
Andorra_AND_2014_WHO_PM25.csv	15-Feb-2017 10:32	386
Angola_AGO_2014_WHO_PM25.csv	15-Feb-2017 10:32	375K
AntiguaandBarbuda_ATG_2014_WHO_PM25.csv	15-Feb-2017 10:32	761
Argentina_ARG_2014_WHO_PM25.csv	15-Feb-2017 10:32	1.0M
Armenia_ARM_2014_WHO_PM25.csv	15-Feb-2017 10:32	11K
Australia_AUS_2014_WHO_PM25.csv	15-Feb-2017 10:32	2.5M
Austria_AUT_2014_WHO_PM25.csv	15-Feb-2017 10:32	35K
Azerbaijan_AZE_2014_WHO_PM25.csv	15-Feb-2017 10:32	32K
Bahamas_BHS_2014_WHO_PM25.csv	15-Feb-2017 10:32	4.5K
Bahrain_BHR_2014_WHO_PM25.csv	15-Feb-2017 10:32	350
Bangladesh_BGD_2014_WHO_PM25.csv	15-Feb-2017 10:32	44K
Barbados_BRB_2014_WHO_PM25.csv	15-Feb-2017 10:32	317
Belarus_BLR_2014_WHO_PM25.csv	15-Feb-2017 10:32	99K
Belgium_BEL_2014_WHO_PM25.csv	15-Feb-2017 10:32	14K
Belize_BLZ_2014_WHO_PM25.csv	15-Feb-2017 10:32	6.8K
Benin_BEN_2014_WHO_PM25.csv	15-Feb-2017 10:32	34K
BhutanBTN_2014_WHO_PM25.csv	15-Feb-2017 10:32	13K
Bolivia,PlurinationalStateof_BOL_2014_WHO_PM25.csv	15-Feb-2017 10:32	342K
BosniaandHerzegovina_BIH_2014_WHO_PM25.csv	15-Feb-2017 10:32	21K
Botswana_BWA_2014_WHO_PM25.csv	15-Feb-2017 10:32	183K
Brazil_BRA_2014_WHO_PM25.csv	15-Feb-2017 10:32	2.6M

Where to Find and View the Data

WHO Website: City Level

The screenshot shows the WHO Global Health Observatory (GHO) data page for 'Exposure to ambient air pollution'. The page is in English and features a navigation bar with links to Health topics, Data, Media centre, Publications, Countries, Programmes, Governance, and About WHO. A search bar is also present. The main content area is titled 'Global Health Observatory (GHO) data' and 'Exposure to ambient air pollution'. It includes a description of the data, a sidebar with 'More PHE data products' (Maps, Reports, Country profiles, Links), and three sections: 'Situation at country level', 'Situation at grid level', and 'Situation at city level'. The 'Situation at city level' section contains links to 'View full size map (PM10)', 'View full size map (PM2.5)', and 'View data | Read more'. Arrows from the text boxes on the right point to these links.

http://www.who.int/gho/phe/ooutdoor_air_pollution/exposure/en/

Global Health Observatory (GHO) data

Exposure to ambient air pollution

The mean ambient air pollution of particulate matter with an aerodynamic diameter of 2.5 μm or less (PM_{2.5}) in country urban areas ranges from less than 10 to over 100 $\mu\text{g}/\text{m}^3$. In urban areas, the mean concentration of particulate matter with an aerodynamic diameter of 2.5 μm or less (PM_{2.5}) ranges from less than 10 to over 100 $\mu\text{g}/\text{m}^3$, and from less than 10 to over 200 $\mu\text{g}/\text{m}^3$ for particulate matter with an aerodynamic diameter of 10 μm or less (PM₁₀)

Situation at country level
View interactive map/graph
View data
Read more

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View data, metadata and detailed methods of estimation

Situation at city level
View full size map (PM₁₀)
View full size map (PM_{2.5})
View data | Read more

More PHE data products
Maps
Reports
Country profiles
Links

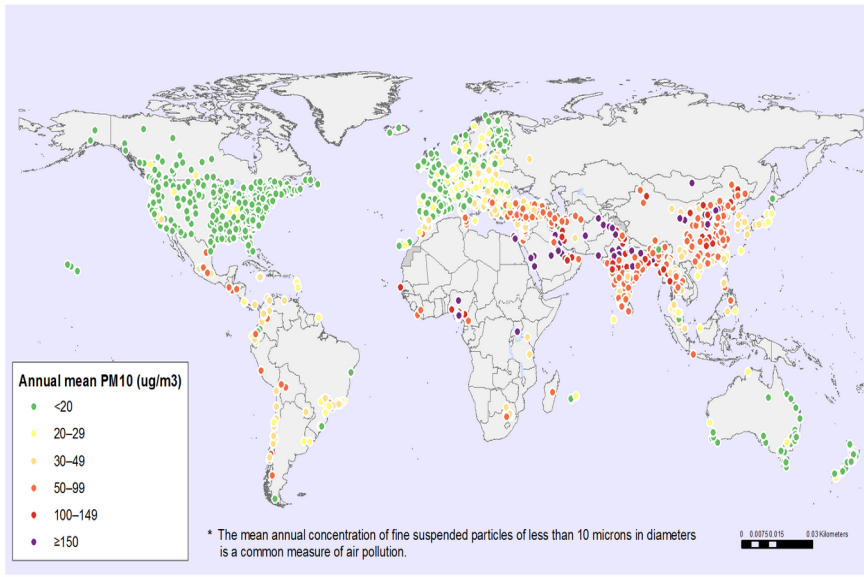
Maps of city level PM₁₀ and PM_{2.5}

.csv file with city level annual means

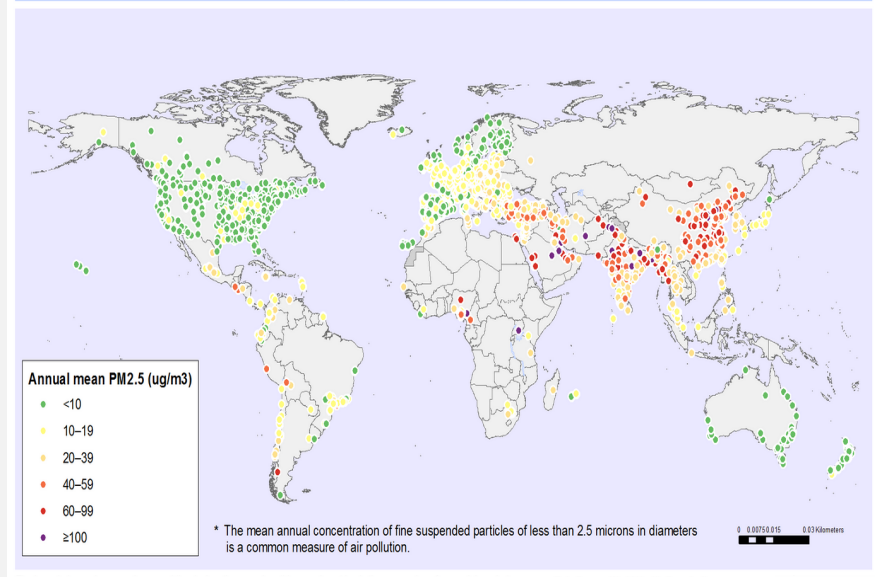
PM_{2.5} at City Level

http://www.who.int/gho/phe/outdoor_air_pollution/exposure/en/

Concentration of particulate matter with an aerodynamic diameter of 10 µm or less (PM10)
in nearly 3000 urban areas*, 2008–2015



Concentration of particulate matter with an aerodynamic diameter of 2.5 µm or less (PM2.5)
in nearly 3000 urban areas*, 2008–2015



A satellite image of the Arctic region, showing the Arctic Ocean and surrounding landmasses including Alaska, Canada, and parts of Europe and Asia. A semi-transparent rectangular box is overlaid on the center of the image, containing the text "Long Term Time Series".

Long Term Time Series

Satellite Derived Surface PM_{2.5} Datasets

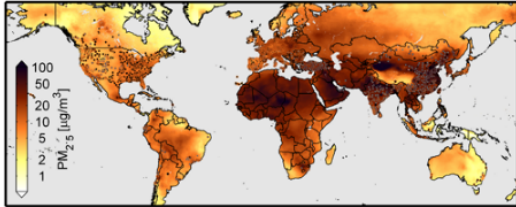
http://fizz.phys.dal.ca/~atmos/martin/?page_id=140

Atmospheric Composition Analysis Group

Research	Publications & Presentations	GEOS-Chem	Satellites	Datasets	SPARTAN	Group Info
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Surface PM2.5

Global Estimates:



We estimate ground-level fine particulate matter (PM2.5) by combining Aerosol Optical Depth (AOD) retrievals from the NASA MODIS, MISR, and SeaWiFS instruments with the GEOS-Chem chemical transport model, and subsequently calibrated to global ground-based observations of PM2.5 using Geographically Weighted Regression (GWR) as detailed in the below reference.

References:
van Donkelaar, A., R.V. Martin, M. Brauer, N. C. Hsu, R. A. Kahn, R. C. Levy, A. Lyapustin, A. M. Sayer, and D. M. Winker, **Global Estimates of Fine Particulate Matter using a Combined Geophysical-Statistical Method with Information from Satellites, Models, and Monitors**, *Environ. Sci. Technol.*, doi: 10.1021/acs.est.5b05833, 2016. [\[Link\]](#)

Estimates prior to 2007 incorporate temporal information from:

Boys, B.L., Martin, R.V., van Donkelaar, A., MacDonell, R., Hsu, N.C., Cooper, M.J., Yantosca, R.M., Lu, Z., Streets, D.G., Zhang, Q., Wang, S., **Fifteen-year global time series of satellite-derived fine particulate matter**, *Environ. Sci. Technol.*, 10.1021/es502113p, 2014. [\[Link\]](#)

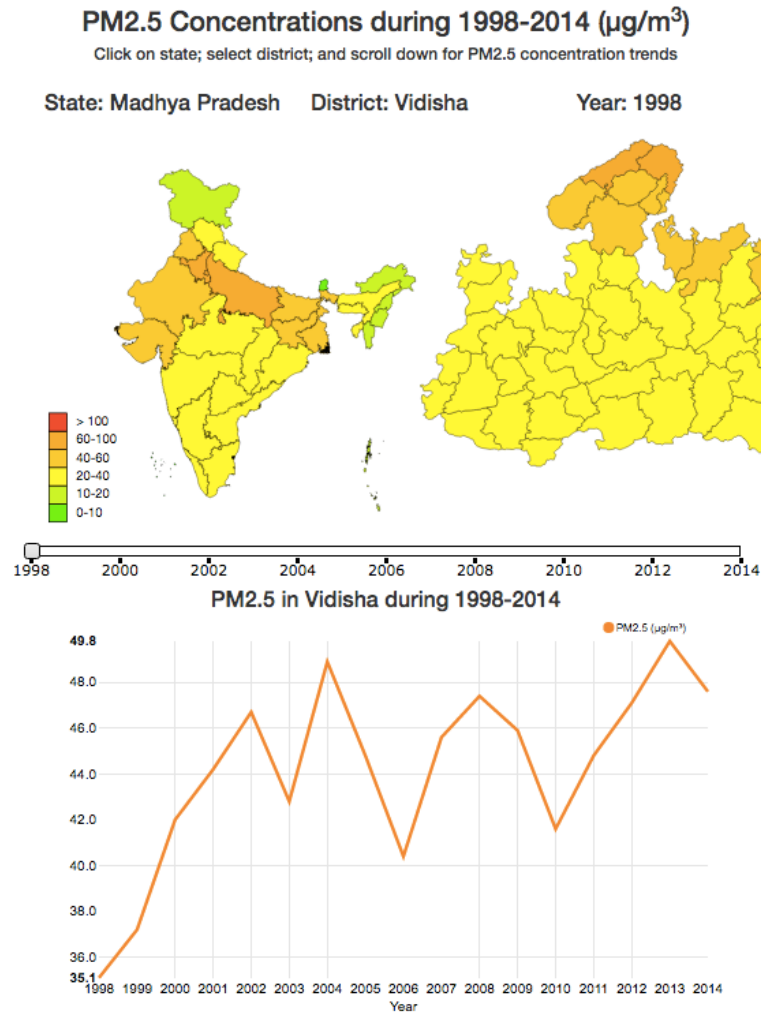
van Donkelaar, A., R. V. Martin, M. Brauer and B. L. Boys, **Global fine particulate matter concentrations from satellite for long-term exposure assessment**, *Environmental Health Perspectives*, 123, 135–143, DOI:10.1289/ehp.1408646, 2015. [\[Link\]](#)

Scientific Datasets:
Global resolved datasets are provided in ArcGIS-compatible NetCDF [.nc] or zipped ASCII [.asc.zip] file. Note that the unzipped ASCII files can be cumbersome. Gridded files use the WGS84 projection. The 0.01° × 0.01° grid contains 12500 latitude coordinates, with centres from 54.995°S to 69.995°N, and 36000 longitude coordinates, with centres from 179.995°W to 179.995°E. The 0.1° × 0.1° grid contains 1250 latitude coordinates, with centres from 54.95°S to 69.95°N, and 3600 longitude coordinates, with centres from 179.95°W to 179.95°E. Corresponding files for Google Earth are also provided [.kmz]. Country means are also provided in a comma separated ascii (.csv) format. Dust and Sea-Salt Removed PM2.5 estimates apply simulated compositional information to our full-composition values, following van Donkelaar et al., EHP, 2015. Other extractions can often be produced upon request. Please contact Aaron van Donkelaar (Aaron.van.Donkelaar@dal.ca) for further information.

All Composition PM2.5:
Satellite-Derived PM2.5, 1998, at 35% RH [µg/m3]
0.1° × 0.1° [.nc] [.asc.zip] [.kmz] [.csv]
0.1° × 0.1° w GWR adjustment [.nc] [.asc.zip] [.kmz] [.csv]
0.01° × 0.01° w GWR adjustment [.nc] [.asc.zip] [.kmz] [.csv]

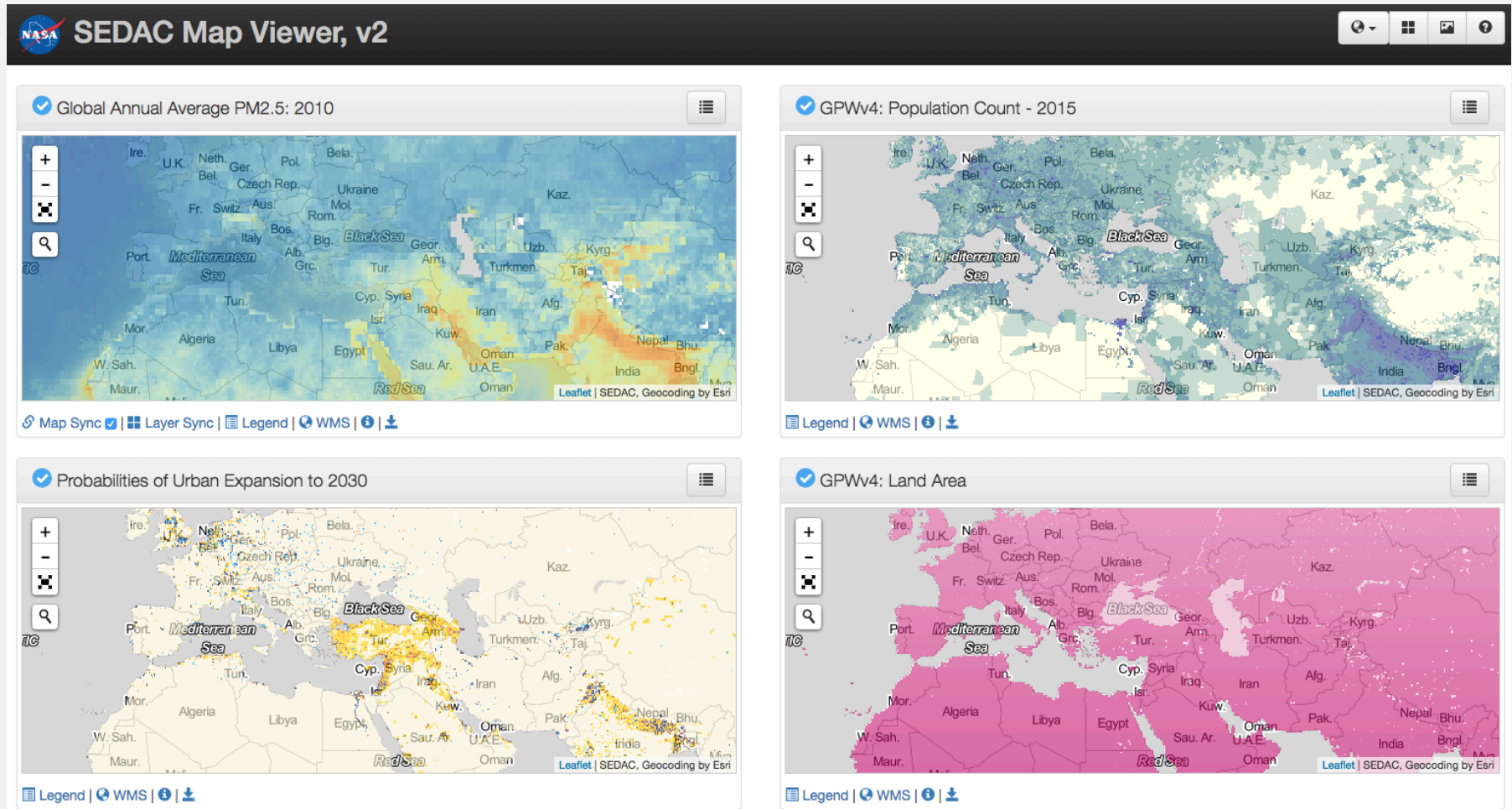
India: Model and Satellite-Derived PM_{2.5}

<http://www.urbanemissions.info/india-satpm25/>



Socioeconomic Data & Applications Center (SEDAC)

<http://sedac.ciesin.columbia.edu/mapping/viewer/#>



State of Global Air

<http://www.stateofglobalair.org/>

